

## AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

### Listing of Claims:

- 1        1. (Currently amended) A method for communicating between a first  
2        semiconductor die and a second semiconductor die through optical signaling,  
3        comprising:
  - 4            converting an electrical signal into an optical signal using an electrical-to-  
5            optical transducer located on a face of the first semiconductor die, ~~wherein the~~ the  
6            ~~electrical-to-optical transducer is a member of a plurality of electrical-to-optical~~  
7            ~~transducers associated with a given channel located on the first semiconductor~~  
8            ~~die;~~  
9            wherein the first semiconductor die and the second semiconductor die are  
10          oriented face-to-face so that the optical signal generated on the first  
11          semiconductor die shines on the second semiconductor die;  
12          passing the optical signal through annuli located within metal layers on the  
13          first semiconductor die to focus the optical signal onto the second semiconductor  
14          die;  
15          receiving the optical signal on a face of the second semiconductor die; and  
16          converting the optical signal into a corresponding electrical signal using an  
17          optical-to-electrical transducer located on the face of the second semiconductor  
18          die, ~~wherein the optical-to-electrical transducer is a member of a plurality of~~  
19          ~~optical-to-electrical transducers associated with the given channel located on the~~  
20          ~~second semiconductor die;~~

21        ~~wherein a plurality of optical signals is transmitted in parallel from the~~  
22        ~~first semiconductor die to the second semiconductor die are electronically steered~~  
23        ~~to correct misalignments between the first semiconductor die and the second~~  
24        ~~semiconductor die.~~

1            2. (Cancelled)

1            3. (Original) The method of claim 1, wherein after generating the optical  
2        signal on the first semiconductor die, the method further comprises using a lens to  
3        focus the optical signal onto the second semiconductor die.

1            4. (Original) The method of claim 1, wherein after generating the optical  
2        signal on the first semiconductor die, the method further comprises using a mirror  
3        to reflect the optical signal, so that the optical signal can shine on the second  
4        semiconductor die without the first semiconductor die having to be coplanar with  
5        the second semiconductor die.

1            5-6 (Canceled).

1            7. (Previously presented) The method of claim 1,  
2        wherein multiple spatially adjacent electrical-to-optical transducers in the  
3        plurality of electrical-to-optical transducers transmit the same signal; and  
4        wherein electronic steering circuits in the first semiconductor die direct  
5        data to the multiple spatially adjacent electrical-to-optical transducers to correct  
6        mechanical misalignment in  $X$ ,  $Y$  and  $\Theta$  coordinates.

1            8. (Previously presented) The method of claim 1,

2       wherein multiple spatially adjacent optical-to-electrical transducers in the  
3       plurality of optical-to-electrical transducers receive the same signal; and  
4       wherein electronic steering circuits in the second semiconductor die direct  
5       data from the multiple spatially adjacent optical-to-electrical transducers to correct  
6       mechanical misalignment in  $X$ ,  $Y$  and  $\Theta$  coordinates.

1       9. (Original) The method of claim 1, wherein the electrical-to-optical  
2       transducer includes one of:  
3           a Zener diode;  
4           a light emitting diode (LED);  
5           a vertical cavity surface emitting laser (VCSEL); and  
6           an avalanche breakdown P-N diode.

1       10. (Original) The method of claim 1, wherein the optical-to-optical  
2       transducer includes one of:  
3           a P-N-diode photo-detector; and  
4           a P-I-N-diode photo-detector.

1       11. (Currently amended) An apparatus for communicating between  
2       semiconductor chips through optical signaling, comprising:  
3           a first semiconductor die;  
4           a second semiconductor die;  
5           an electrical-to-optical transducer located on a face of the first  
6       semiconductor die, which is configured to convert an electrical signal into an  
7       optical signal, ~~wherein the electrical-to-optical transducer is a member of a~~  
8       ~~plurality of electrical-to-optical transducers associated with a given channel~~  
9       ~~located on the first semiconductor die;~~

10       wherein the first semiconductor die and the second semiconductor die are  
11   oriented face-to-face so that the optical signal generated on the first  
12   semiconductor die shines on the second semiconductor die;  
13       annuli located within metal layers on the first semiconductor die  
14   configured to focus the optical signal onto the second semiconductor die;  
15       an optical-to-electrical transducer located on a face of the second  
16   semiconductor die, which is configured to convert the optical signal received from  
17   the first semiconductor die into a corresponding electrical signal, ~~wherein the~~  
18   ~~optical-to-electrical transducer is a member of a plurality of optical-to-electrical~~  
19   ~~transducers associated with the given channel located on the second~~  
20   ~~semiconductor die;~~  
21       ~~wherein a plurality of optical signals is transmitted in parallel from the~~  
22   ~~first semiconductor die to the second semiconductor die are electronically steered~~  
23   ~~to correct misalignments between the first semiconductor die and the second~~  
24   ~~semiconductor die.~~

1           12. (Cancelled)

1           13. (Original) The apparatus of claim 11, further comprising a lens  
2   configured to focus the optical signal onto the second semiconductor die.

1           14. (Original) The apparatus of claim 11, further comprising a mirror  
2   configured to reflect the optical signal, so that the optical signal can shine on the  
3   second semiconductor die without the first semiconductor die having to be  
4   coplanar with the second semiconductor die.

1           15-16 (Canceled).

1        17. (Previously presented) The apparatus of claim 11,  
2        wherein multiple spatially adjacent electrical-to-optical transducers in the  
3        plurality of electrical-to-optical transducers transmit the same signal; and  
4        wherein electronic steering circuits in the first semiconductor die direct  
5        data to the multiple spatially adjacent electrical-to-optical transducers to correct  
6        mechanical misalignment in  $X$ ,  $Y$  and  $\Theta$  coordinates.

1        18. (Previously presented) The apparatus of claim 11,  
2        wherein multiple spatially adjacent optical-to-electrical transducers in the  
3        plurality of optical-to-electrical transducers receive the same signal; and  
4        wherein electronic steering circuits in the second semiconductor die direct  
5        data from the multiple spatially adjacent optical-to-electrical transducers to correct  
6        mechanical misalignment in  $X$ ,  $Y$  and  $\Theta$  coordinates.

1        19. (Original) The apparatus of claim 11, wherein the electrical-to-optical  
2        transducer includes one of:  
3              a Zener diode;  
4              a light emitting diode (LED);  
5              a vertical cavity surface emitting laser (VCSEL); and  
6              an avalanche breakdown P-N diode.

1        20. (Original) The apparatus of claim 11, wherein the optical-to-optical  
2        transducer includes one of:  
3              a P-N-diode photo-detector; and  
4              a P-I-N-diode photo-detector.

1        21. (Currently amended) A computer system including semiconductor  
2        chips that communicate with each other through optical signaling, comprising:

3           a first semiconductor die containing one or more processors;

4           a second semiconductor die containing circuitry that communicates with

5       the one or more processors;

6           an electrical-to-optical transducer located on a face of the first

7       semiconductor die, which is configured to convert an electrical signal into an

8       optical signal, ~~wherein the electrical-to-optical transducer is a member of a~~

9       ~~plurality of electrical-to-optical transducers associated with a given channel~~

10      ~~located on the first semiconductor die;~~

11           wherein the first semiconductor die and the second semiconductor die are

12       oriented face-to-face so that the optical signal generated on the first

13       semiconductor die shines on the second semiconductor die;

14           annuli located within metal layers on the first semiconductor die

15       configured to focus the optical signal onto the second semiconductor die;

16           an optical-to-electrical transducer located on a face of the second

17       semiconductor die, which is configured to convert the optical signal received from

18       the first semiconductor die into a corresponding electrical signal, ~~wherein the~~

19       ~~optical-to-electrical transducer is a member of a plurality of optical-to-electrical~~

20       ~~transducers associated with the given channel located on the second~~

21       ~~semiconductor die;~~

22           ~~wherein a plurality of optical signals is be transmitted in parallel from the~~

23       ~~first semiconductor die to the second semiconductor die are electronically steered~~

24       ~~to correct misalignments between the first semiconductor die and the second~~

25       ~~semiconductor die.~~

1           22. (Cancelled)

1           23. (Original) The computer system of claim 21, further comprising a lens

2       configured to focus the optical signal onto the second semiconductor die.

1        24. (Original) The computer system of claim 21, further comprising a  
2        mirror configured to reflect the optical signal, so that the optical signal can shine  
3        on the second semiconductor die without the first semiconductor die having to be  
4        coplanar with the second semiconductor die.

1        25-26 (Canceled).

1        27. (Previously presented) The computer system of claim 21,  
2        wherein multiple spatially adjacent electrical-to-optical transducers in the  
3        plurality of electrical-to-optical transducers transmit the same signal; and  
4        wherein electronic steering circuits in the first semiconductor die direct  
5        data to the multiple spatially adjacent electrical-to-optical transducers to correct  
6        mechanical misalignment in  $X$ ,  $Y$  and  $\Theta$  coordinates.

1        28. (Previously presented) The computer system of claim 21,  
2        wherein multiple spatially adjacent optical-to-electrical transducers in the  
3        plurality of optical-to-electrical transducers receive the same signal; and  
4        wherein electronic steering circuits in the second semiconductor die direct  
5        data from the multiple spatially adjacent optical-to-electrical transducers to correct  
6        mechanical misalignment in  $X$ ,  $Y$  and  $\Theta$  coordinates.

1        29. (Original) The computer system of claim 21, wherein the electrical-to-  
2        optical transducer includes one of:  
3            a Zener diode;  
4            a light emitting diode (LED);  
5            a vertical cavity surface emitting laser (VCSEL); and  
6            an avalanche breakdown P-N diode.

1       30. (Original) The computer system of claim 21, wherein the optical-to-  
2       optical transducer includes one of:

- 3           a P-N-diode photo-detector; and  
4           a P-I-N-diode photo-detector.

1       31. (Previously presented) The method of claim 1, wherein after  
2       generating the optical signal on the first semiconductor die, the method further  
3       comprises passing the optical signal through an interposer sandwiched between  
4       the first semiconductor die and the second semiconductor die, wherein the  
5       interposer contains one or more waveguides that direct the optical signal, so that  
6       the optical signal shines on the second semiconductor die.

1       32. (Previously presented) The apparatus of claim 11, further comprising  
2       an interposer sandwiched between the first semiconductor die and the second  
3       semiconductor die, wherein the interposer contains one or more waveguides that  
4       direct the optical signal, so that the optical signal shines on the second  
5       semiconductor die.

1       33. (Previously presented) The computer system of claim 21, further  
2       comprising an interposer sandwiched between the first semiconductor die and the  
3       second semiconductor die, wherein the interposer contains one or more  
4       waveguides that direct the optical signal, so that the optical signal shines on the  
5       second semiconductor die.

1       34. (New) The method of claim 1,  
2       wherein the electrical-to-optical transducer is a member of a plurality of  
3       electrical-to-optical transducers located on the first semiconductor die; and

4           wherein the optical-to-electrical transducer is a member of a plurality of  
5   optical-to-electrical transducers located on the first semiconductor die;

6           whereby a plurality of optical signals can be transmitted in parallel from  
7   the first semiconductor die to the second semiconductor die.

1           35.    (New) The apparatus of claim 11,  
2           wherein the electrical-to-optical transducer is a member of a plurality of  
3   electrical-to-optical transducers located on the first semiconductor die; and

4           wherein the optical-to-electrical transducer is a member of a plurality of  
5   optical-to-electrical transducers located on the first semiconductor die;

6           whereby a plurality of optical signals can be transmitted in parallel from  
7   the first semiconductor die to the second semiconductor die.

1           36.    (New) The computer system of claim 21,  
2           wherein the electrical-to-optical transducer is a member of a plurality of  
3   electrical-to-optical transducers located on the first semiconductor die; and

4           wherein the optical-to-electrical transducer is a member of a plurality of  
5   optical-to-electrical transducers located on the first semiconductor die;

6           whereby a plurality of optical signals can be transmitted in parallel from  
7   the first semiconductor die to the second semiconductor die.